SAWTRI BULLETIN

SOUTH AFRICAN
WOOL TEXTILE RESEARCH INSTITUTE
OF THE CSIR
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SIXTH QUINQUENNIAL WOOL TEXTILE RESEARCH CONFERENCE — PRETORIA 26th AUGUST — 3rd SEPTEMBER 1980

Another five years since the Fifth Quinquennial in Aachen, West Germany (2-11 September 1975), have gone by culminating in the hosting of the Sixth Quinquennial by South Africa in the CSIR's magnificent and luxurious Conference Centre at Scientia in Pretoria. It has been a period of intense organisation involving thousands of man-hours spent in writing letters, despatching telexes, cables and telegrams, scrutinising and editing Conference papers, reserving aircraft passenger flights and hotel accommodation, arranging social activities and sightseeing tours for delegates and their wives and a host of accompanying activities, too many to enumerate here. All these have been the responsibility of the Organising Committee. A lion's share of the work befell Mr Neville Vogt, Regional Liaison Officer in Port Elizabeth of the CSIR and his office was the hub around which it all revolved. SAWTRI's involvement has been deep, both organisationally, as well as by virtue of its contributions to the Conference itself.

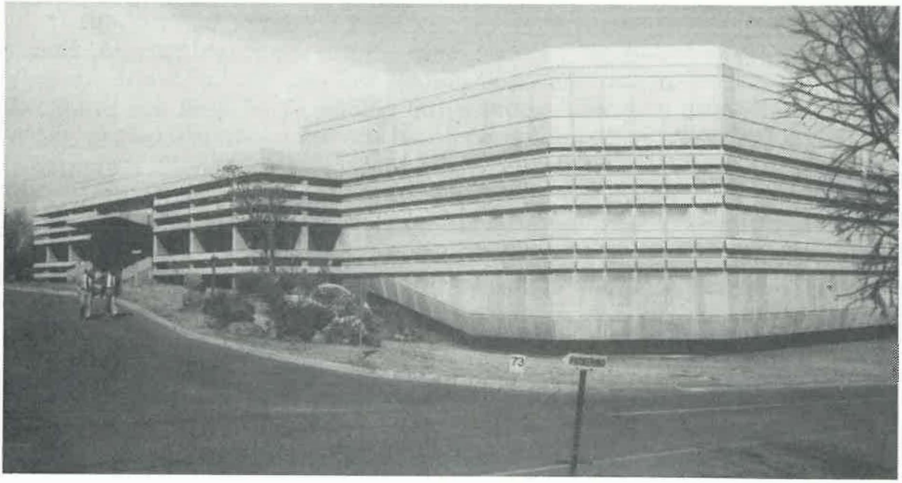
The Conference was attended by some 230 delegates from South Africa, Australia, New Zealand, United Kingdom, Mauritius, Uruguay, Argentina, Spain, Italy, West Germany, Belgium, Holland, Sweden, Norway, Japan, United States of America, Switzerland, Israel and France.

In his opening address, the State President, the Honourable Mr M. Viljoen expressed his appreciation of the presence of delegates from no fewer than 19 countries. He said that the wool industries in both South Africa and Australia could be traced to a gift to the then Governor of the Cape from Spanish royal stock, of six merino sheep. Now, the President said, South Africa had a sheep population of 30 million and one third of South Africa's farmers kept sheep or goats. About a 100 million kg of wool was produced annually of which some 26 million was used for textile manufacture in South Africa, while exports of wool produced a revenue of R200 million annually. Referring to the South African Wool and Textile Research Institute, Mr Viljoen said its research covered a wide variety of textile fibres which had led to valuable interchange of ideas in processing techniques.

Mr P. W. van Rooyen, Chairman of the South African Wool Board, in his welcoming address said that wool producers realised the necessity for sacrificing a substantial proportion of their earnings for research. The scientists present, he said, had made great contributions to the improvement of wool production and processing and he thanked them on behalf of 30 000 wool growers.

In welcoming the delegates, Mr Tony Hobson, Chairman of the Mohair Board said that this was the first time that mohair had been given full recogni-

The State President, the Hon. M. Viljoen delivering his opening address



The CSIR Conference Centre at Scientia, Pretoria

tion at a Conference of this nature. Apart from the fact that mohair featured in many discussions, five papers specifically dealing with mohair were read. Mr Hobson then related the somewhat amusing origin of the Mohair industry in South Africa. In 1838, he said, some Angora rams and one ewe were imported with the object of improving the meat quality of local stock. Due to some international intrigue involving Turkey and Great Britain at the time of despatch, the rams were sterilised! What the Turkish supplier did not know, however, was that the the ewe was pregnant! Upon arrival at the Cape the ewe duly gave birth to a little ram which became the father of the South African Mohair Industry!

Prof. Zahn, Director of the Wool Research Institute, Aachen, West Germany and organising chairman of the 1975 Conference in his address of greetings said that many scientific disciplines now contributed to improve the technology of wool and textile processing and the latest consideration to assume importance was environmental planning. (This was evidenced to no small degree during the Conference in papers dealing with effluent treatment.) Prof. Zahn congratulated Prof. D. P. Veldsman and his organising committee, together with the staff of the CSIR Conference Secretariat under Mr Keith McCusker on the high standard of their work. At the end of his address he handed over to Prof. Veldsman the gavel which had been used to call delegates

Miss Anne van Wyk of the CSIR Conference Secretariat and Mr Desmond Varley, Editor of the Conference daily newspaper: "Woolcon '80"

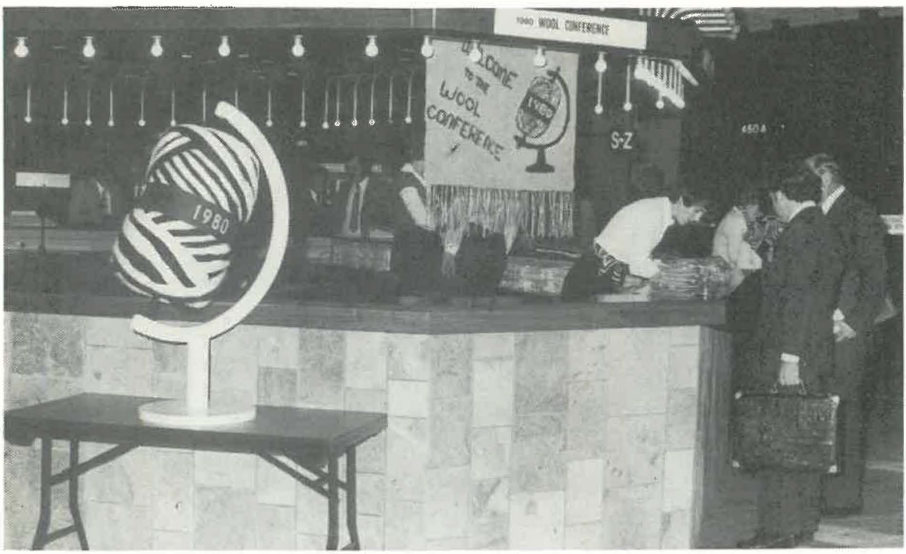
At the Registration Desk

Prof. H. Zahn, organising chairman of the 5th Quinquennial Conference in Aachen in 1975 about to hand the Conference Gavel to this year's organising chairman, Prof. D. P. Veldsman to order at previous Quinquennial Conferences. Dr Veldsman later presented the gavel to SAWTRI's Director, Dr D. W. F. Turpie during the tea given in honour of the State President.

In extending a welcome to the delegates, Dr C. F. Garbers, President of the Council for Scientific and Industrial Research said that, one of the most advanced centres of its kind in the world, the CSIR Conference Centre was completed in 1977 after the architectural staff of the CSIR had scoured the world for ideas in conference management, facilities and equipment. He said that more than 30 000 delegates had already attended 107 major scientific and technical conferences at the centre during a period of 12 months.

Dr Garber's description of the Conference Centre was no idle boast. Indeed, apart from the excellent facilities such as a dining hall seating 300 people, committee rooms, three Auditoria of which the largest is capable of accommodating about 500 people, the support services are outstanding. Full audio-visual equipment is built into the three auditoria and is operated from the podium or from audio projection rooms adjoining the auditoria. Full interpreting facilities inclusive of individual microphones with call-buttons and language channel selection dials are available. This particular feature concerning microphones throughout the auditoria admirably facilitates discussion after presentation of papers.

The social aspects of the Conference were no less successful than the Conference itself. To start the process of fraternising and getting acquainted on the



The three dimensional Conference emblem on display at the Registration counter

INSTITUTE NEWS

Director of SAWTRI Visits Textile Institute Headquarters

On his recent visit to the UK and Europe, the Director of SAWTRI, Dr D. W. F. Turpie visited the Textile Institute in Manchester and had discussions with Mr Richard Denyer, General Secretary; Mr David Love, Editor : TI & I and Mr Stansfield, qualifications officer.

As a result of his visit greater cooperation and liaison between the two institutes can be expected to follow. All SAWTRI publications from now on will be available (including 350 publications already in print) in the Textile Institute library and the Textile Institute will have extra copies of new Technical Reports, Bulletins and Special publications, etc., for sale at current prices to give SAWTRI a world-wide readership through the Textile Institute members.

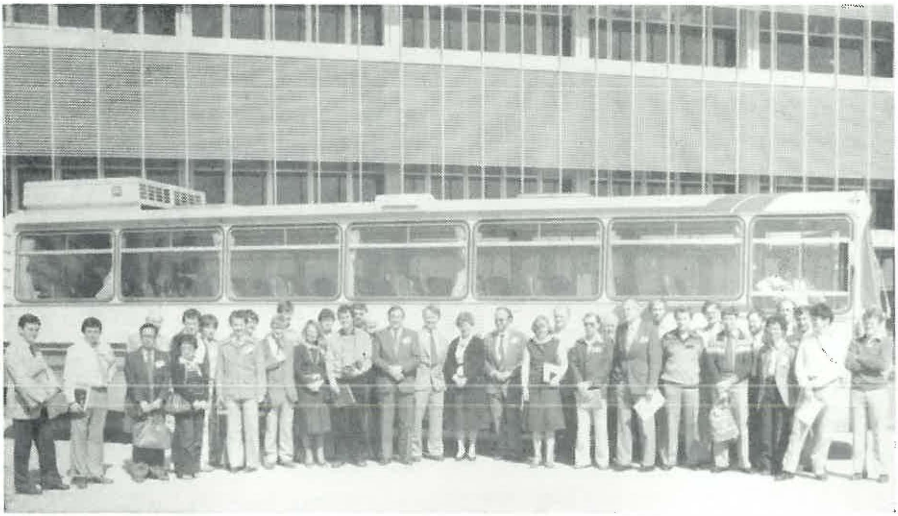
Visitors to SAWTRI

During the past three months, SAWTRI received visits from a large number of important personalities. During July, Mr M. W. Burgess, Cotton Productivity Adviser, Cotton Training Centre, Gatooma, Zimbabwe; Mr

Dr D. W. F. Turpie (right) with Mr Richard Denyer, General Secretary of the Textile Institute during the former's recent visit to the Institute in Manchester

Dr B. E. King of WIRA and Mrs King flanked by Dr Turpie (right) and Mr Neville Vogt, CSIR Regional Liaison Officer during the King's visit to SAWTRI before the Conference

Dr D. E. A. Plate of the CSIRO with Dr L. Hunter, Assistant Director of SAWTRI (centre) and Mr G. A. Robinson, who is responsible for fabric development and garment technology at SAWTRI



The group of 40 scientists and their wives who paid a visit to SAWTRI prior to attending the 6th Quinquennial Conference, in Pretoria

Mr G. A. Robinson explaining something in the Weaving Department to Mr T. B. Harmsworth from the Melbourne College of Textiles; Mr R. Foulds of CSIRO; Dr D. Orwin from WRONZ and Dr A. R. Haly of CSIRO

Dr Y. T. Tanaka and Mrs Tanaka discussing a point of interest in the Dyeing and Finishing Department at SAWTRI

Dr J. M. Bennett of the Australian Wool Corporation in earnest conversation with Mr G. A. Robinson

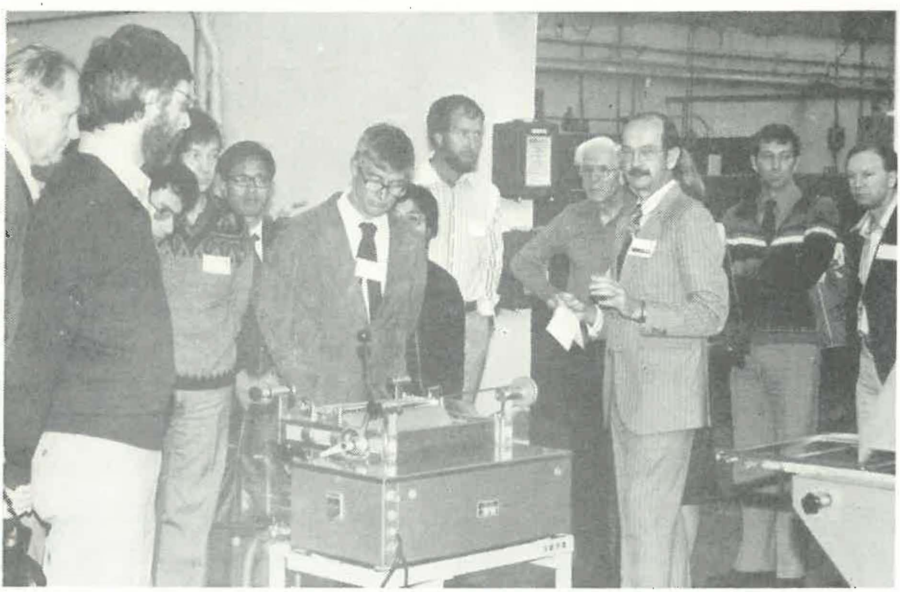
Neils Hauffe, Scientific and Technical Consul of the South African Consulate in Los Angeles, USA; Mr Sandy Neville, President of the I.W.T.O., Australia, and Mr J. Bueda of Spain. The steady stream of visitors continued unabatedly throughout August and well into September. Heading the list was Prof. M. Lewin, Director of the Israel Fibre Institute in Jerusalem; followed by Dr Judith Bennett, Controller, Textile Research, R & D Dept., Australian Wool Corporation; Prof. Dr. Ing. and Mrs J. Lünenschloss of the Institut für Textiltechnik, Aachen, West Germany; Dr W. Kunz of Ciba-Geigy, Basle, Switzerland; a tour group of 40 delegates to the 1980 Wool Textile Research Conference; Dr and Mrs B. King of WIRA in Leeds and Prof. M. Chaikin, Head of the School of Textile Technology and Dean of The Faculty of Applied Science, University of New South Wales, Australia.

On September 5th and 6th, Dr W. Lonie, of the Scottish College of Textiles, Galashiels, Scotland spent some time at the Institute and had talks with Mr Hannes van der Merwe as part of the latter's arrangements for his visit overseas.

On September 9th the Director of the Wool Research Organisation of New Zealand (WRONZ), Dr W. S. Simpson, accompanied by Drs D. A. Ross

Dr T. Jellinek; Dr J. R. Cook; Dr G. E. Wood, all from CSIRO and Dr Y. T. Tanaka from the Research Institute for Polymers and Textiles in Japan looking on attentively while Dr Turpie points out something interesting in connection with SAWTRI's modified Repco Spinning Machine

Mr Neville Vogt explaining some aspect of *Phormium tenax* processing to, from left to right: Dr D. E. Rivett, Dr I. C. Watt, Dr G. F. Wood, Dr A. B. Haly, all from CSIRO; Dr J. S. McCracken, from the University of New South Wales and Dr I. M. Russel, CSIRO



Dr N. J. J. van Rensburg, responsible for all wet processing research at SAWTRI talking to members of the pre-conference tour party

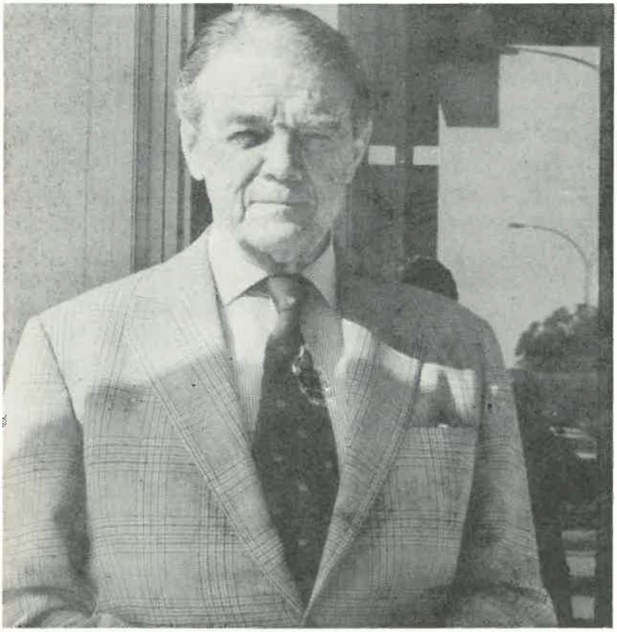
and A. J. McKinnon paid an extended visit to SAWTRI. The Director, Dr Turpie; Assistant Director, Dr Hunter and group leaders: Dr van Rensburg and Mr Robinson took the visitors through the Institute and had discussions on matters of mutual interest to the two organisations.

A similar visit was paid by a number of Technical Managers of the I.W.S. on September 10th.

On September 11th, Dr Bruce Tinnock, Senior Instructor in the Department of Wool Science, Lincoln College, Canterbury, New Zealand was received at the Institute by Dr Turpie. Dr Bruce Early, one of the three young scientists sponsored to attend the Quinquennial Conference spent the day at SAWTRI. Dr Early is attached to the Wool Research Organisation of New Zealand where he is concerned with wool scouring.

On August 20th, Mr M. A. Strydom accompanied the tour group of Conference delegates including Prof. R. Postle of the School of Textile Technology, University of New South Wales; Dr and Mrs D. S. Taylor,

Dr's Harmsworth, J. A. MacLaren (CSIRO), Cook, McCracken and Jellinek in discussion with Dr van Rensburg and Mr E. Weideman, SAWTRI's Head of Textile Chemistry, extreme right



Mr Sandy Neville of Australia, President of the ITWO

Dr Hunter of SAWTRI with the group of IWS Technical Managers in the Scouring Department during their recent visit to SAWTRI

CSIRO, Australia; Dr and Mrs Tanaka of the Research Institute for Polymers and Textiles, Ibraki, Japan; Prof. and Mrs J. Lünenschloss of the Institut für Textiltechnik der RWTH, Aachen, West Germany; Prof. M. Lewin, Israel Fiber Research Institute, Jerusalem and Dr A. R. Haly of the CSIRO on a tour of Port Elizabeth. They visited the Mohair Board, Farmers' Brokers Cooperative Ltd., and the Gideon Joubert Technical Centre of the South African Wool Board. They also visited various places of historical interest in the city. The following day the group were taken by motor coach to Mr Pat Grewar's Mohair farm "Canchassie" in the Jansenville district. From there they went to Graaff-Reinet where places of historical interest were visited. They also called on Mr R. Rubidge of Wellwood in the Graaff-Reinet district where they were shown records of the Wellwood sheep stud dating back to 1838. The Palaentological Museum on the farm was a great attraction. Before returning to Port Elizabeth, the group was taken to Grootfontein Agricultural College where they were shown over the fleece testing centre. From Port Elizabeth the group boarded an aircraft which took them to Johannesburg and hence to the 1980 Conference.

Right: Dr Judith Bennett and the Waterwheel on Mr Richard Rubidge's farm "Wellwood" in the Graaff-Reinet District

Below: Dr D. Orwin (centre) and Prof. M. Lewin having discussions with Mr G. Erasmus in a Laboratory at Grootfontein Agricultural College, Middelburg

Staff Appointments

Since the previous edition of "SAWTRI BULLETIN" a number of staff appointments have been made:

Dr Miriam Shiloh, Textile Phycisist, formerly attached to the Israel Fiber Institute in Jerusalem joined the staff at the beginning of September to complete another two-month contract in the Textile Physics Division. Dr Shiloh has come to examine the effect of fibre properties on fabric properties studying a wide range of wool lots. This is a continuation of a study started at SAWTRI some years ago and involves analysing the results accumulated over the years.

Mr W. Fraser transferred from the National Physics Research Laboratory to take up the dual post of Head of *Phormium tenax* processing and officer in charge of electronics at the beginning of September.

Miss L. Grobler joined the administrative staff as Senior Clerk to deal with certain staff matters and accounts.

Dr Peter Delaney, who holds a Ph.D. degree in Chemical Physics from Salford University, Lancashire, has joined the staff of Textile Physics. Prior to coming to South Africa, Dr Delaney was Chairman of the Science Department, St. Augustine's College, Nassau in the Bahamas after having taught at Loreto College, Manchester, U.K.

Mr J. P. van der Merwe, who worked at SAWTRI previously has returned to head Woollen Processing. With this in mind, Mr van der Merwe has left for Galashiels in Scotland where he will spend a year or two at the Scottish College of Textiles carrying out research on the woollen system of processing.

Prof. D. M. Lewin, Director of the Israel Fiber Institute admiring a piece of cloth woven at SAWTRI in conversation with Mr G. A. Robinson

THE EFFECT OF THE REGAIN OF SEED COTTON ON THE MICRONAIRE, FINENESS AND MATURITY OF THE COTTON AFTER MINIATURE GINNING

by S. SMUTS and L. HUNTER

ABSTRACT

It appears that, within practical ranges, correct sample preparation is more important for reliable air-flow test results than fibre regain. In-the-field testing or testing at the gin would therefore be feasible provided a way is found to prepare the cotton sample in an acceptable manner and provided extremes in regain are avoided. Micronaire readings are less sensitive to fibre preparation than either fineness or maturity, the latter being particularly sensitive. Correct fibre preparation requires a means for reducing the foreign matter in the cotton and for randomising and separating the fibres.

INTRODUCTION

In certain cases it would be convenient if the micronaire, fineness and maturity of a cotton could be measured shortly after ginning, without having to condition or prepare the cotton in the usual manner. In view of this, it was decided to investigate the effects of differences in the regain of seed cotton on air-flow results. It was shown previously[1] that sample preparation can have a profound effect on fibre properties as determined on an IIC-Shirley Fineness/Maturity Tester. Ginned cotton or samples blended on a fibre blender could not be used directly for determining the fibre properties by air-flow. However, samples prepared on a miniature card or on a Shirley Analyser were suitable. Clearly, therefore, fibre preparation is an important factor when considering alternative test procedures.

In a previous study[2] the effect of regain on the micronaire, fineness and maturity of cotton as determined on an air-flow instrument was investigated. It was found that, when the conditioned mass of the sample specimen was kept constant then both micronaire and fineness increased significantly with an increase in regain, whereas the maturity ratio hardly changed. The magnitude of the effect was largely independent of micronaire or fineness. The change in micronaire was almost solely due to the reduction in the actual mass of *cotton* fibre present in the sample with increasing regain. The measured fibre linear density (fineness) was also found to closely approximate that predicted from the linear density of the dry fibre and the mass of water absorbed at each relative humidity. The effects were generally much smaller and reversed when a constant dry mass of fibre was tested in each case regardless of the regain. In this case the magnitude of the effect increased as micronaire increased. Nevertheless, within the approximate range of 25% to 80%, relative humidity only had a relatively small effect on micronaire and fineness. Thus, for example, an increase of about 0,2 micronaire was observed when the relative humidity increased from 25% to 80%.

In the investigation referred to above the cotton samples were prepared in the normal manner for the air-flow tests, only the regain of the fibres being changed. The present study on the other hand was aimed at establishing the effect of the regain of a sample of seed cotton on air-flow results obtained on cotton shortly after ginning and to determine the effect of fibre preparation on the results. Clearly, however, the results obtained in a study of this nature are merely indicative of trends since the changes in the regain of a cotton sample as a result of ginning will depend upon a variety of factors, some of which would be difficult, if not impossible, to quantify and control in practice.

EXPERIMENTAL

As a control, a sample of seed cotton was ginned on a Shirley miniature roller gin, then opened on a Shirley Analyser, dried in an oven at 40°C for 2 hours and conditioned overnight at 20°C/65% RH. Thereafter the micronaire, fineness and maturity ratio was determined in the normal manner on an IIC-Shirley Fineness/Maturity Tester. The results are shown in Table I.

Samples of *seed cotton* (approximately 25 to 30 g in mass) were dried in an oven at 105°C and the bone dry mass of each determined. These samples were then conditioned at different levels of relative humidity for at least 18 hours before the conditioned mass of the seed cotton was determined in each case. The regain of the *seed cotton* was calculated from its bone-dry and conditioned mass. After this, the conditioned samples were conveyed in weighing bottles to the miniature gin (which was in a room conditioned at 20°C and 50% RH) where they were ginned immediately upon removal from the weighing bottles. Both the seed-component and the fibre-component of the seed cotton were carefully collected and the mass of each determined with as little delay as possible. The micronaire, fineness and maturity ratio of the ginned fibre were determined immediately afterwards in the standard manner

TABLE I

CHARACTERISTICS OF FIBRES WHICH WERE BOTH GINNED AND PREPARED

Micronaire	3,37
Fineness (mtex)	156
Maturity Ratio	0,75

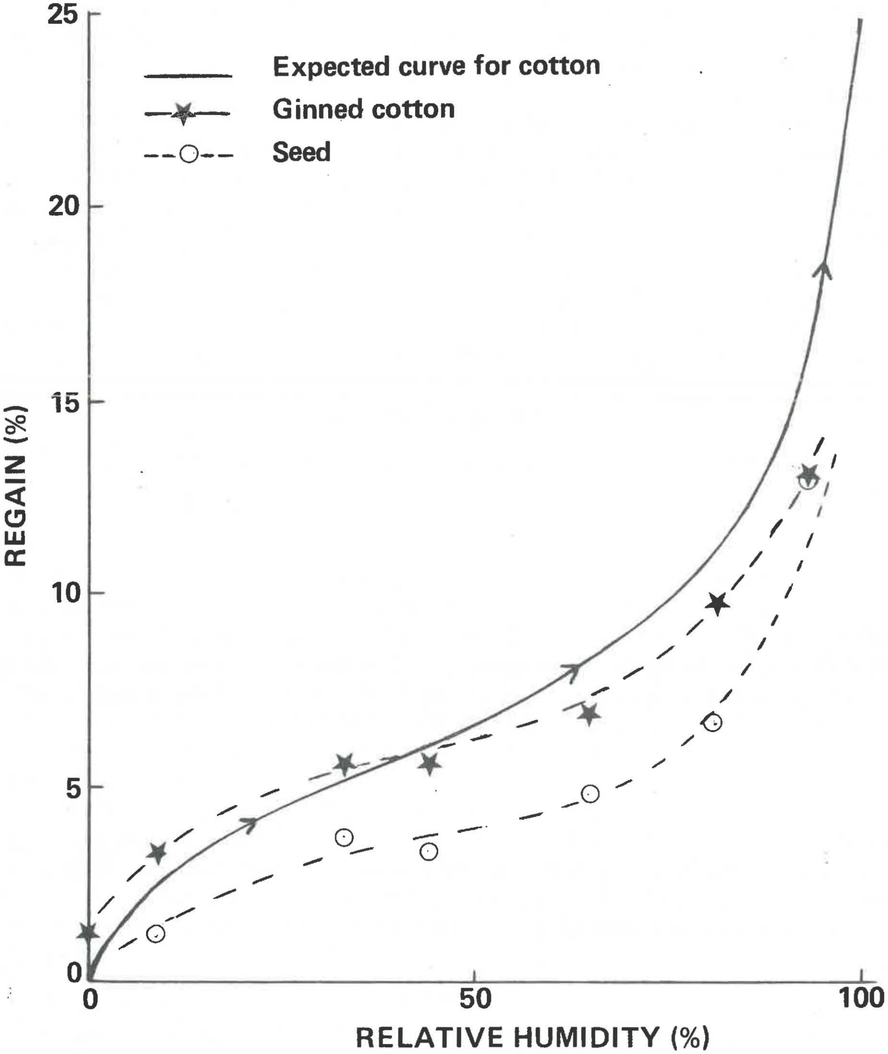


FIGURE 1

The Relationship between Regain of Ginned Cotton and Seed and Relative Humidity at which Seed Cotton had been conditioned

at 20°C/65% RH. The mass of both the seed and fibre was again determined afterwards in order to establish the changes in mass which occurred during the actual airflow test. The difference between the mass of the cotton (and seed) after ginning and after the above test was found to be less than 0,7%. Both the seed and fibre components were now dried (separately) in an oven at 105°C. The bone-dry mass of each component together with the mass of the ginned samples were used to calculate the regain of the seed and fibre respectively. These regain values will not agree with the *expected* regain (Fig 1) because, upon ginning, the fibres will loose or gain some moisture depending upon whether their original regains were higher or lower than the equilibrium regain at the relative humidity (50% RH) prevailing during ginning. The means of the three determinations of each experimental condition (i.e. at each RH) are given in Table II and the results are also depicted in Figs 2 to 4.

The scatter in Fig 2 (i.e. for the results obtained on the ginned fibre) was larger than would normally be expected and the increase in micronaire with an increase in regain was much larger than that found previously[2] for ginned cotton which had been prepared (i.e. passed through the Shirley Analyser). Also the fineness values were much higher and the maturity much lower than the correct values as given in Table I. The experiment was therefore repeated on samples which were prepared after ginning (only one determination was made

TABLE II

SOME PROPERTIES OF THE SEED COTTON, THE SEED AND THE GINNED FIBRE AT VARIOUS RELATIVE HUMIDITIES*
(Temperature = 20°C)

PRIOR TO GINNING		DETERMINED AFTER GINNING AT 50% RH				
RH (%)	Regain of Seed Cotton (%)	Regain of seed** (%)	Regain of fibre** (%)	Micronaire	Fineness (mtex)	Maturity Ratio
0	0	0	1,3	3,31	192	0,58
9	1,4	1,2	3,4	3,25	194	0,56
33	4,2	3,7	5,7	3,50	215	0,55
44	3,6	3,3	5,7	3,64	218	0,58
65	5,8	4,8	7,0	3,98	227	0,62
81	7,9	6,7	9,8	3,90	241	0,57
93	13,3	13,0	13,1	4,56	284	0,58

*Each result is the mean of three separate determinations.
**These are the regains of the cotton samples at the time of testing and they will not agree with the expected regains because of changes during ginning.

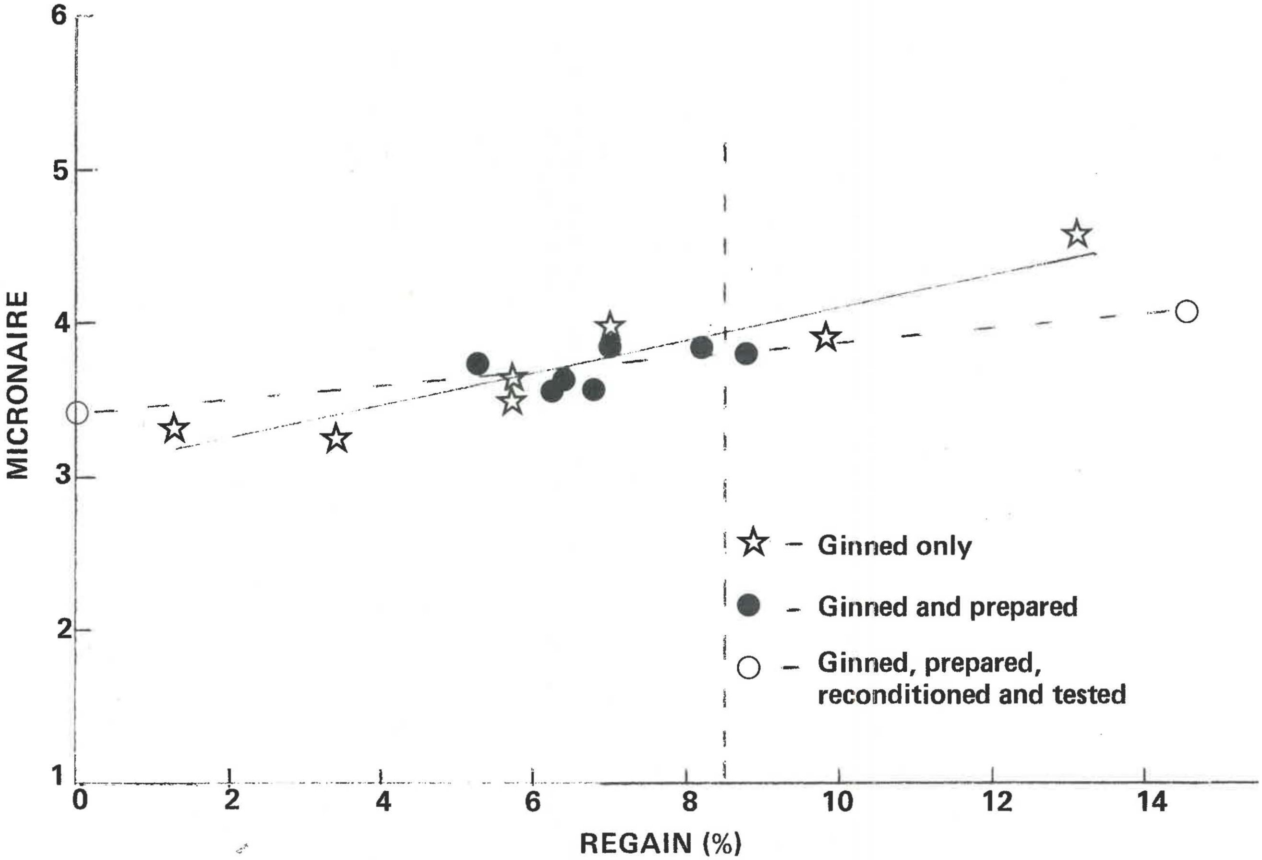


FIGURE 2

The Effect of Regain of Cotton Sample at Time of Testing on Micronaire

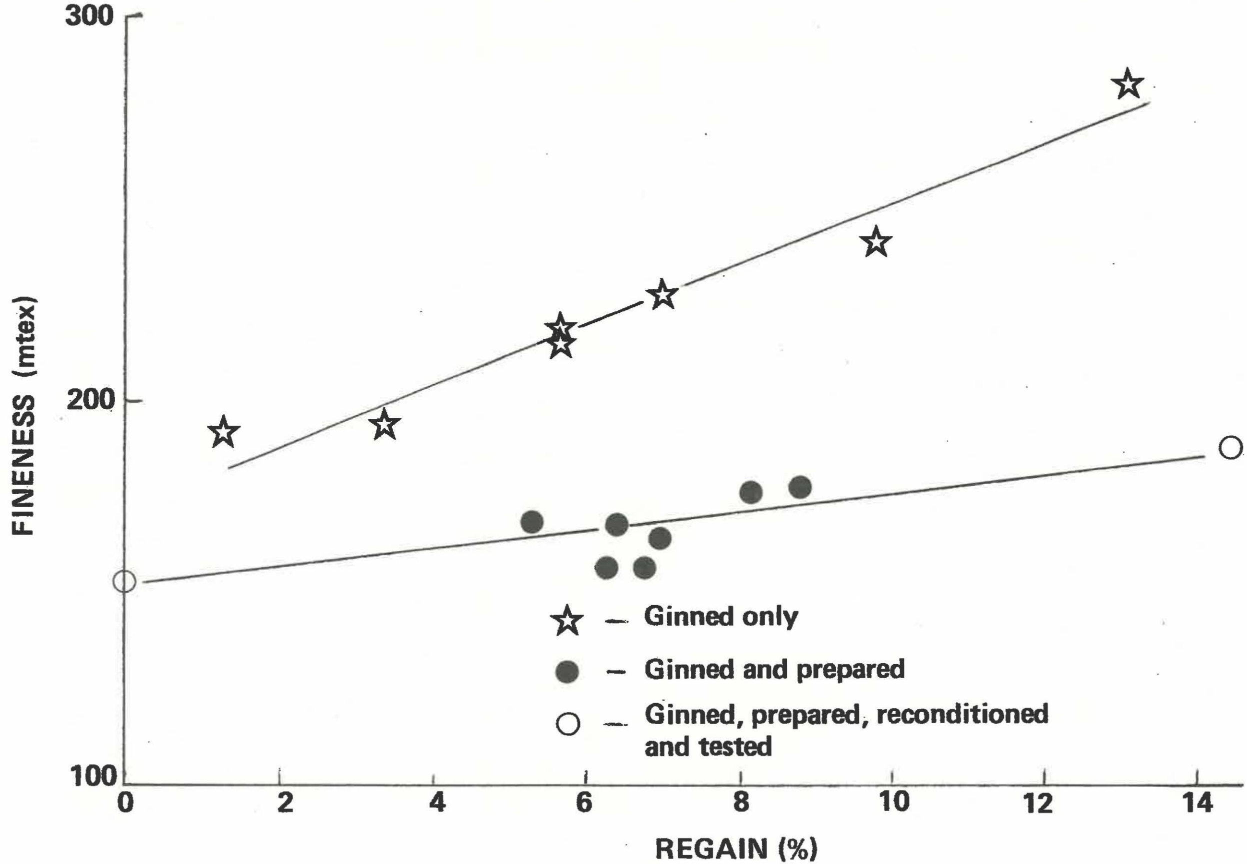


FIGURE 3

The Effect of Regain of Cotton Sample at Time of Testing on Fineness

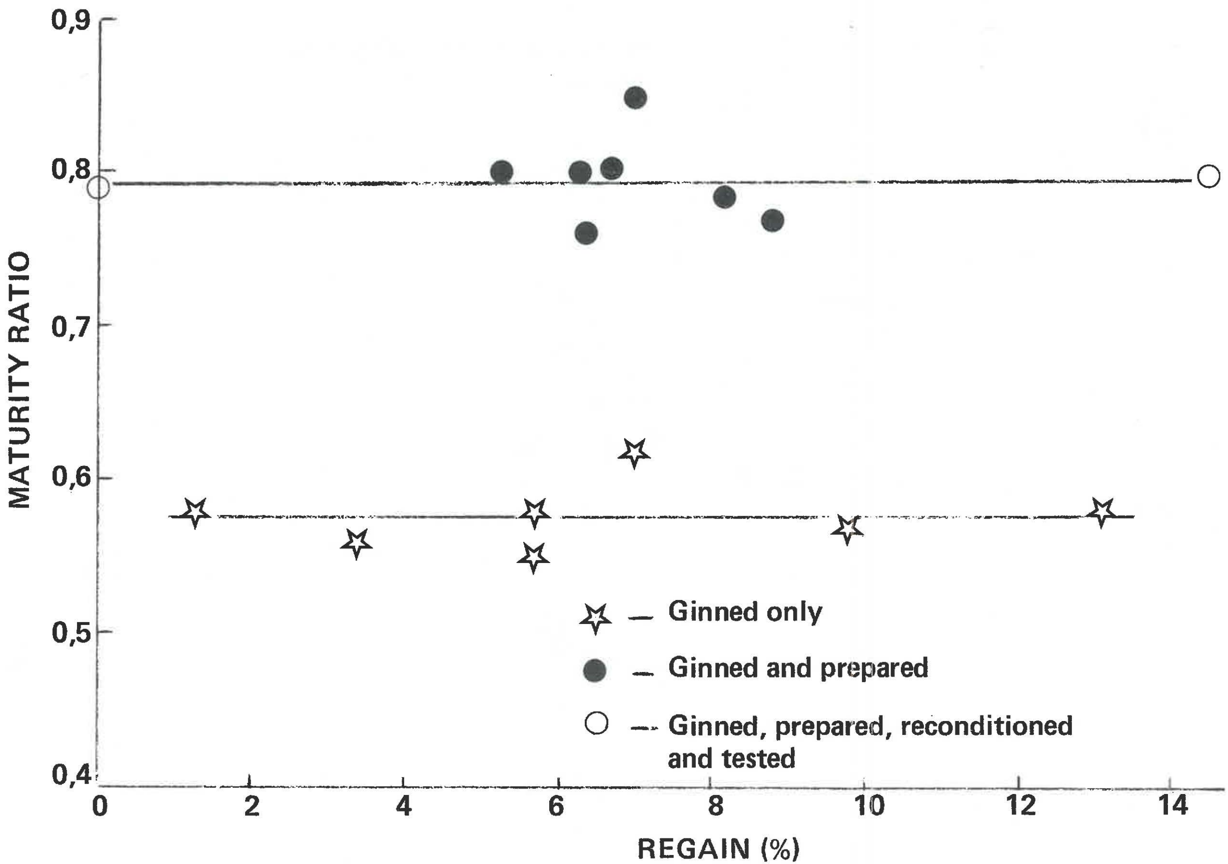


FIGURE 4

The Effect of Regain of Cotton Sample at Time of Testing on Maturity Ratio

TABLE III

A COMPARISON OF RESULTS OBTAINED ON COTTON DIRECTLY AFTER GINNING AND AFTER BOTH GINNING AND PREPARATION*

Relative Humidity at which seed cotton was conditioned	GINNED COTTON				GINNED AND PREPARED FIBRE			
	Regain (%)	Micronaire	Fineness (mtex)	Maturity Ratio	Regain** (%)	Micronaire	Fineness (mtex)	Maturity Ratio
0	1,3	3,29	187	0,59	5,3	3,75	169	0,80
9	4,2	2,95	178	0,53	6,3	3,55	157	0,80
33	5,4	3,36	215	0,52	6,4	3,61	168	0,76
44	6,1	3,73	213	0,61	7,0	3,87	166	0,85
65	6,5	3,84	221	0,61	6,8	3,55	157	0,80
81	10,7	4,23	250	0,61	8,2	3,87	177	0,79
93	13,5	3,95	244	0,56	8,8	3,80	178	0,77

*One determination only in each case

**Regain of cotton sample at time of testing.

TABLE IV

RESULTS OBTAINED DIRECTLY AFTER CONDITIONING ON FIBRES WHICH HAD BEEN BOTH GINNED AND PREPARED*

RH (%)	Regain (%)**	Micronaire	Fineness (mtex)	Maturity Ratio
0	0	3,43	153	0,79
93	14,5	4,08	188	0,80

*One determination only in each case
**Regain of cotton sample at the time of testing

at each experimental condition). The results are given in Tables III and IV and are also plotted in Figs 2 and 3.

RESULTS AND DISCUSSION

Before the results are discussed it is important to emphasize that the micronaire, fineness and maturity ratio were plotted against the regain of the cotton sample at the time of testing (i.e. the regain either after ginning or ginning and preparation, as the case may be).

Ginned Samples

The regain for the *seed cotton* at a specific relative humidity should be very close to the true values but, as already explained, the regain values of the cotton lint (after ginning) will not correspond to the expected values. Obviously the differences will depend upon the atmospheric conditions in which the seed cotton was ginned as well as the time and nature of the exposure during ginning, and this must be kept in mind when ginning is carried out under ambient conditions.

The seed (which formed about 60% by mass of this particular seed cotton) had, a lower regain than the fibre. As in the case of the cotton lint, the regain curve for the seed may be expected to deviate slightly from the expected curve for seed because of moisture loss or gain during actual ginning. This deviation should not be very large since the rate of regain change with change in relative humidity, in the case of the seed, appears to be small.

The micronaire results obtained on the ginned samples were very variable. This is probably due to the fact that ginning does not "prepare" the samples very well for the test and "channelling" could, therefore, be a major source of variation. Trash and dirt, present in the ginned sample could also contribute to the variation of the results. The channelling effect may be expected to become more pronounced as the relative humidity at which the samples were originally conditioned increase since as relative humidity increases the actual mass of the fibre contained in the sample will actually contain fewer fibres (i.e. more moisture) thereby increasing the likelihood and severity of channelling.

Ginned and Prepared Samples

The *few* results obtained on fibres which had been both ginned and prepared clearly show the importance of the state of preparation of the sample. Apart from reducing the rate of change in micronaire with regain, the results were also less variable. During preparation the fibres were so well opened that individual fibres were exposed to the atmosphere (20°C/50% RH) and this caused a very rapid *reconditioning* of the sample so that the regain of all the samples tended towards the equilibrium regain at 50% RH, i.e. that prevailing during ginning and preparation. In addition to its effect on micronaire, the preparation (i.e. state of openness) of the sample also had a large effect on the measured levels of the fineness and maturity ratio.

The changes in fineness with regain and preparation are shown in Fig 3. The measured fibre linear density increased with an increase in regain and was reduced by preparation on the Shirley Analyser. The rate of change of fineness with regain was also reduced after preparation. The fineness at any particular regain (RH) of the samples which had been both ginned and prepared could be predicted fairly well from the fineness at zero regain and the calculated or actual regain. This was, however, not the case for samples which had been ginned only.

Maturity ratio was independent of regain but increased greatly after preparation (Fig 4).

CONCLUSIONS

Within practical ranges of humidity fibre preparation of a cotton sample had a more important effect than regain on air-flow test results for maturity and fineness. Micronaire reflected the opposite trend. Results obtained on the ginned cotton were very variable, probably because ginning alone does not achieve proper fibre preparation and separation. It is concluded that correct fibre preparation is more important for reliable fineness and maturity results obtained by the airflow-test than controlling the fibre regain. The micronaire results were not so critically dependent upon fibre preparation.

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A NOTE ON THE FADING OF DYES ON KERATIN FIBRES DIFFERING WIDELY IN LUSTRE

by N. J. J. VAN RENSBURG

ABSTRACT

Various keratin fibres which differ significantly in lustre, such as mohair, Corriedale, Falkland and merino wool were dyed with 12 different dyes and then exposed to Xenon light for various periods. It appeared that lustre had no effect on the lightfastness ratings or the rate of fading.

INTRODUCTION

One of the most important properties of the mohair fibre and one which distinguishes it from most other keratin fibres is its high lustre[1]. Basically lustre is a surface phenomenon which depends on the way in which the incident light is reflected from the surface. When the angle of reflectance equals the angle of incidence the light is reflected specularly, but when the angle of reflectance differs from the angle of incidence the light is said to be reflected diffusely[2]. Diffusely reflected light is basically the result of scattering once the light has entered the fibre. In practice, incident light is reflected specularly as well as diffusely by textile fibres and when the ratio of specularly to diffusely reflected light increases the lustre of the fibre increases. The lustre of different types of keratin fibres differs widely and it is possible that such differences could affect the lightfastness ratings of the various fibres. In general, different types of wool and mohair do not differ significantly in their chemical composition, and it was considered that if differences in lustre do affect the lightfastness of the fibres, this could possibly be detected through differences in the lightfastness values of the fibres.

To date very little information is available on this topic and it was decided to investigate the matter in some detail. Consequently mohair and different types of wool which differed widely in lustre[3, 4] were selected and dyed with a range of dyes differing in their lightfastness ratings. The samples were then exposed to Xenon light for different periods, followed by colour measurements and the calculation of the colour difference values. This note describes the results obtained during the investigation.

EXPERIMENTAL

Five different woven fabrics comprising merino, Falkland and Corriedale wool, mohair and a blend of mohair/Falkland wool (60/40) were used in this study. The fabrics were scoured and then dyed with 12 different dyes (0,5% dye on mass of fabric) which differed significantly in colour and lightfastness rating. Undyed control samples as well as the dyed fabrics were then exposed to Xenon light (Xenotest 450 LF) and the colour of the samples was measured after 15, 30, 45, 60, 75 and 90 hours on a Harrison-Shirley Colorimeter. The colour difference values between the unexposed samples and the samples which had been exposed to Xenon light for the different times were then calculated, and the results subjected to statistical analysis.

RESULTS AND DISCUSSION

The lightfastness ratings and the ΔE, ΔC, ΔH and ΔL values of the various samples are given in the Appendix. Statistical analysis of the results showed that the 12 different dyes differed significantly in their rates of fading, which was to be expected since the dyes were selected to differ in their lightfastness ratings. When the rates of fading of the five different fabrics comprising the different types of fibres were compared, however, no differences were noticed. This was the case for the dyed fabrics, as well as for the undyed samples. It is clear, therefore, that no differences in the rates of fading of dyes could be detected on keratin fibres differing widely in their degree of lustre, despite the fact that dyes which differed significantly in colour and lightfastness were used. (Fig 1 shows the effect of Xenon light on the ΔE values of some of the samples after exposure for various times.) The effect of the fibre lustre on the rate of discolouration of undyed and dyed keratin fibres therefore seems to be very small and could not be detected by normal lightfastness ratings or conventional colour measurement.

SUMMARY

Five different fabrics comprising fibres which differed significantly in terms of lustre, namely merino, Corriedale and Falkland wool, mohair and blends of mohair/Falkland wool were dyed with 12 different dyes and then exposed to Xenon light for various periods up to 90 hours. The colour values of the samples after the different exposure times were determined, and the colour difference values between the unexposed and the exposed samples were then calculated. Despite the fact that widely different dyes which differed significantly in colour and lightfastness ratings were used, no differences could be detected between the five different fabrics in terms of lightfastness ratings or rates of fading. It seems, therefore, that the contribution of fibre lustre to the lightfastness or fading of dyed keratin fibres is insignificant.

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THE USE OF PROPRIETARY NAMES

®denotes registered trade marks. Hostalan is the trade mark of Messrs Hoechst, Palatin of Messrs BASF, Carbolan, Coomassie and Lissamine of Messrs ICI and Kiton and Neolan of Messrs Ciba-Geigy. The fact that products with proprietary names have been used in this investigation does not in any way imply that SAWTRI recommends them or that there are not substitutes with equal or better values.

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APPENDIX

ΔE, ΔL, ΔC, ΔH AND LIGHTFASTNESS VALUES OF THE SAMPLES

DELTA-E VALUES AFTER VARIOUS EXPOSURE TIMES (HOURS)

Dye	Fabric*	15	30	45	60	75	90	Light-fastness
Untreated	A	1,30	2,19	1,18	2,21	2,59	2,33	
	B	3,84	4,60	4,60	4,28	4,76	4,38	
	C	2,24	2,92	3,17	3,29	3,54	1,38	
	D	4,89	3,61	3,60	3,69	3,22	3,65	
	E	2,48	2,82	2,52	2,89	2,74	3,23	
®Hostalan Scarlet R	A	1,22	1,90	3,27	4,44	5,29	5,73	4
	B	2,20	3,20	4,37	5,68	6,14	7,19	4—5
	C	1,30	2,53	2,85	4,48	5,24	6,04	4—5
	D	1,65	3,16	4,45	5,87	7,10	7,97	4—5
	E	2,35	3,54	5,66	7,26	8,90	9,82	4—5
®Hostalan Red R	A	4,14	4,57	8,13	11,38	13,96	16,50	3
	B	3,43	4,94	8,06	10,29	12,33	14,10	3
	C	4,49	7,61	11,62	15,40	18,71	22,07	3
	D	15,72	3,33	8,62	10,47	13,19	15,23	3
	E	4,35	8,45	11,97	15,10	17,59	20,42	3
®Hostalan Brilliant Red B	A	7,81	5,19	7,18	26,12	10,52	12,20	4
	B	1,91	3,74	5,37	6,95	8,53	9,70	4
	C	2,38	4,61	6,61	8,49	10,02	11,32	4
	D	8,54	3,90	5,40	7,70	9,38	11,28	4
	E	6,28	3,94	5,79	7,77	9,66	11,26	4
®Coomassie Red R	A	11,76	6,10	8,95	11,39	13,23	14,89	3
	B	3,96	5,81	8,75	10,72	12,37	13,78	3—4
	C	9,75	6,80	9,71	11,94	13,68	12,31	3
	D	2,48	5,10	7,61	9,60	10,79	31,33	3—4
	E	3,51	7,35	9,51	11,76	12,65	15,88	3
®Carbolan Crimson BS	A	4,14	7,80	10,29	13,16	15,73	16,90	2
	B	4,63	7,91	10,67	12,86	15,23	16,99	2
	C	11,20	8,59	11,91	14,69	17,01	19,94	2
	D	15,46	6,03	8,89	10,94	12,80	21,15	2—3
	E	4,76	8,18	11,29	13,82	16,92	18,48	2
®Coomassie Brilliant Blue G	A	8,49	14,30	18,47	22,14	26,17	28,78	2—3
	B	7,03	12,97	17,08	20,34	24,27	25,51	2
	C	8,33	13,11	16,65	19,82	22,82	25,44	2
	D	4,91	11,47	14,91	17,75	20,39	22,48	2
	E	7,79	12,75	16,78	20,24	22,59	24,78	2—3
®Kiton Green B	A	12,33	16,78	21,46	24,79	27,10	29,67	2—3
	B	12,59	16,18	21,10	20,16	24,54	26,16	2—3
	C	11,74	15,65	20,40	23,80	26,96	28,45	2—3
	D	10,84	10,41	15,93	18,26	20,77	22,45	2—3
	E	11,56	10,73	16,90	19,10	22,19	24,82	2—3
®Kiton Green V	A	8,07	7,75	12,58	15,54	18,41	19,81	3
	B	9,40	8,89	15,19	15,77	17,46	19,72	3
	C	9,71	9,34	14,42	17,32	19,64	22,29	3
	D	8,71	7,53	12,64	15,07	16,53	18,50	3
	E	9,60	9,23	13,79	17,51	18,96	21,34	3
®Lissamine Green SF	A	8,81	8,13	13,04	16,57	17,81	48,47	2—3
	B	7,46	6,24	10,39	12,91	14,01	15,85	2—3
	C	10,26	13,58	17,35	20,52	21,31	22,82	2—3
	D	7,33	9,49	13,10	15,81	16,58	18,17	2—3
	E	6,71	9,74	13,26	15,82	16,85	17,73	2—3
®Palatin Fast Bordeaux RN	A	1,08	2,29	2,27	3,00	2,78	3,97	4—5
	B	2,10	2,25	2,34	2,92	3,05	3,58	4—5
	C	1,44	1,57	1,57	2,67	2,83	3,57	4—5
	D	0,89	1,46	1,47	2,02	2,08	2,48	4—5
	E	1,33	1,83	2,14	2,49	2,90	3,54	4—5
®Palatin-Fast Blue GGN	A	0,76	1,11	1,51	1,72	2,09	2,43	5
	B	1,31	1,35	2,94	2,35	2,66	2,91	5
	C	1,44	1,16	1,48	1,81	2,14	2,56	5
	D	1,09	1,06	1,30	1,69	1,93	2,14	5
	E	1,32	1,06	1,13	1,25	1,66	1,88	5
®Neolan Brown 2G	A	1,78	2,56	3,20	3,75	4,04	4,59	4—5
	B	1,90	2,78	3,32	3,77	4,04	4,48	4—5
	C	1,55	2,01	2,52	3,15	3,65	4,27	4—5
	D	1,56	1,34	2,42	2,90	3,36	4,15	4—5
	E	2,02	2,62	3,02	3,50	4,04	4,50	4—5

* A = Mohair; B = Mohair/Falkland; C = Corriedale; D = Falkland; E = Merino

DELTA-H VALUES AFTER VARIOUS EXPOSURE TIMES (HOURS)

Dye	Fabric	15	30	45	60	75	90
Untreated	A	0,30	0,46	−0,66	0,00	0,38	0,59
	B	−1,37	−1,45	−1,95	0,89	−1,50	−1,56
	C	0,73	0,59	−1,20	1,04	1,04	−1,21
	D	−1,23	−1,54	−1,44	1,00	−1,01	−1,28
	E	0,73	−1,39	0,68	0,80	−1,23	−1,56
® Hostalan Scarlet R	A	−0,52	−0,15	−1,74	−2,51	−3,20	−3,32
	B	−0,00	−0,80	−2,09	−3,22	−3,38	−4,74
	C	−0,16	−0,28	−1,68	−1,94	−2,44	−3,81
	D	−0,47	−1,49	−2,75	−3,83	−4,66	−5,40
	E	0,97	2,18	−3,77	−5,02	−6,45	−7,09
® Hostalan Red R	A	1,78	−3,09	6,29	9,35	11,76	14,17
	B	2,58	3,37	6,52	8,57	10,19	11,70
	C	−3,56	6,33	9,65	13,31	16,13	19,20
	D	15,54	−2,42	7,39	9,16	11,31	12,93
	E	2,54	6,81	9,90	12,72	14,88	17,32
® Hostalan Brilliant Red B	A	−7,41	−4,06	5,58	25,66	8,50	9,80
	B	0,85	−2,45	−4,08	−5,68	6,84	7,69
	C	−1,35	−3,08	−5,24	−6,77	−8,38	9,76
	D	8,30	−2,77	4,40	6,44	8,06	9,42
	E	5,96	−2,81	−4,34	−6,42	−8,23	9,50
® Coomassie Red R	A	11,50	−4,43	6,93	9,27	10,50	11,85
	B	3,00	−4,31	6,99	8,74	10,03	11,23
	C	9,30	−4,80	7,59	9,39	11,00	−11,78
	D	1,41	3,83	6,16	7,97	8,86	30,52
	E	−1,00	5,26	7,50	9,62	10,35	12,99
® Carbolan Crimson BS	A	2,37	6,14	8,32	10,98	−13,31	−14,28
	B	3,69	−6,75	−9,09	11,31	−13,19	−14,95
	C	−10,82	−7,55	−10,64	13,12	15,34	−17,61
	D	−15,32	−4,98	−7,64	−9,64	−10,91	−13,02
	E	3,76	−6,66	−9,70	−12,09	−14,38	−16,00
® Coomassie Brilliant Blue G	A	−4,34	−6,67	−7,48	−8,24	−9,20	−9,89
	B	−2,26	−3,10	−3,79	−4,09	−4,68	−4,65
	C	−3,20	−5,18	−5,89	−7,17	−7,86	−8,90
	D	−1,64	−3,39	−4,10	−4,69	−4,99	−5,68
	E	−2,75	−5,19	−6,01	−7,27	−7,66	−8,30
® Kiton Green B	A	11,91	−15,38	−19,28	−21,65	−22,72	−24,64
	B	12,29	−15,07	−18,73	−17,16	−21,00	−22,07
	C	11,51	14,85	−19,02	−21,43	−23,54	−24,50
	D	10,56	9,99	15,14	−16,88	−18,89	−19,71
	E	11,27	10,28	−15,64	−17,43	−19,77	−21,40
® Kiton Green V	A	7,90	7,62	12,36	15,30	18,17	19,45
	B	9,23	8,76	15,01	15,59	17,26	19,48
	C	9,60	9,23	14,28	17,14	19,37	−21,89
	D	8,52	7,43	12,49	14,92	16,37	18,27
	E	9,45	9,11	13,62	17,35	18,74	21,03
® Lissamine Green SF	A	−8,34	−7,61	−12,03	−15,16	−15,90	47,85
	B	−7,18	−5,88	−9,79	−12,11	−13,01	−14,60
	C	−10,17	−13,14	−16,27	−19,15	−19,35	−20,64
	D	−7,09	−8,87	−12,18	−14,60	−14,89	−16,27
	E	−6,45	−9,10	−12,36	−14,63	−15,32	−15,97
® Palatin Fast Bordeaux RN	A	0,18	−0,81	−0,61	−1,57	−1,48	−2,49
	B	−0,06	−0,95	−1,01	−1,74	−1,94	−2,53
	C	−0,16	−0,94	−0,62	−1,72	−1,98	−2,69
	D	−0,15	−0,80	−0,83	−1,39	−1,54	−1,88
	E	−0,65	−0,90	−1,23	−1,58	−1,99	−2,55
® Palatin Fast Blue GGN	A	0,50	0,58	0,45	0,58	0,63	−0,44
	B	1,14	0,60	−0,79	1,18	1,07	−0,72
	C	1,42	1,04	0,51	0,65	0,63	−0,41
	D	1,00	0,89	0,82	1,05	1,07	0,92
	E	1,24	0,97	0,91	0,82	1,03	0,79
® Neolan Brown 2G	A	−0,07	−0,01	−0,07	−0,23	−0,35	−0,43
	B	−0,44	−0,38	−0,16	−0,33	−0,90	−0,22
	C	−0,50	−0,32	−0,37	−0,32	−0,58	−1,22
	D	−0,40	−0,22	−0,60	−0,23	−0,33	−1,36
	E	−1,27	−1,38	−1,42	−1,47	−1,52	−1,74

DELTA-C VALUES AFTER VARIOUS EXPOSURE TIMES (HOURS)

Dye	Fabric	15	30	45	60	75	90
Untreated	A	−1,29	−2,16	−1,11	−2,11	−2,56	−2,32
	B	−3,62	−4,58	−4,51	−4,25	−4,76	−4,37
	C	−2,22	−2,86	−3,15	−3,27	−3,51	0,09
	D	−3,82	−3,53	−3,51	−3,68	−3,22	−3,63
	E	−2,46	−2,78	−2,47	−2,85	−2,71	−3,19
® Hostalan Scarlet R	A	0,03	−1,08	−2,58	−3,48	−4,26	−4,50
	B	−0,73	−1,76	−3,31	−4,52	−5,27	−5,97
	C	−0,54	−1,22	−2,17	−3,85	−4,64	−5,40
	D	−0,72	−2,39	−3,97	−5,14	−6,26	−7,05
	E	−1,16	−2,48	−4,82	−6,35	−8,03	−8,73
® Hostalan Red R	A	−0,77	−3,31	−6,31	−9,04	−11,52	−13,57
	B	−2,49	−3,43	−6,36	−8,30	−10,01	−10,85
	C	−3,73	−6,48	−9,83	−13,18	−16,17	−18,73
	D	−14,66	2,09	−7,31	−8,90	−11,17	−12,57
	E	−2,54	−7,01	−9,99	−12,58	−14,94	−17,14
® Hostalan Brilliant Red B	A	7,40	−4,08	−5,59	−25,57	−8,49	−9,61
	B	−0,84	−2,47	−4,10	−5,70	−6,84	−7,54
	C	−1,39	−3,14	−5,29	−6,82	−8,42	−9,60
	D	−8,28	−2,78	−4,28	−6,43	−8,03	−9,19
	E	−5,94	−2,84	−4,37	−6,45	−8,25	−9,50
® Coomassie Red R	A	−10,49	−4,84	−7,35	−9,68	−10,96	−12,28
	B	−2,98	−4,78	−7,37	−9,05	−10,43	−11,56
	C	−8,67	−5,18	−8,00	−9,78	−10,60	10,95
	D	−1,24	−4,02	−5,94	−7,97	−9,08	−27,58
	E	−1,12	−5,54	−6,63	−9,30	−10,18	−12,99
® Carbolan Crimson BS	A	−2,40	−6,16	−8,35	−11,01	−13,34	−14,30
	B	−3,69	−6,75	−9,08	−11,31	−13,20	−14,95
	C	−10,83	−7,54	−10,64	−13,14	−15,36	−17,62
	D	−15,32	−4,96	−7,63	−9,64	−10,84	−10,25
	E	−3,76	−6,60	−9,70	−12,06	−14,02	−16,00
® Coomassie Brilliant Blue G	A	−7,11	−11,65	−15,26	−18,17	−21,13	−22,83
	B	−5,96	−11,10	−14,36	−17,09	−20,24	−21,38
	C	−7,31	−11,11	−14,13	−16,31	−18,65	−20,14
	D	−4,18	−10,17	−12,98	−15,26	−17,55	−18,98
	E	−7,13	−11,12	−14,66	−17,22	−19,17	−20,64
® Kiton Green B	A	−12,22	−16,08	−20,19	−22,59	−23,38	−24,89
	B	−12,51	−15,71	−19,88	−18,31	−22,21	−23,24
	C	−11,66	−15,34	−19,85	−22,56	−24,73	−25,64
	D	−10,76	−10,32	−15,72	−17,72	−19,97	−21,01
	E	−11,47	−10,60	−16,54	−18,37	−20,97	−22,78
® Kiton Green V	A	−7,97	−7,68	−12,44	−15,38	−18,24	−19,51
	B	−9,29	−8,81	−15,07	−15,65	−17,30	−19,52
	C	−9,64	−9,27	−14,32	−17,18	−19,39	−21,89
	D	−8,55	−7,46	−12,53	−14,96	−16,39	−18,29
	E	−9,48	−9,13	−13,63	−17,37	−18,76	−21,05
® Lissamine Green SF	A	−8,02	−7,18	−11,11	−13,26	−13,22	1,34
	B	−7,09	−5,73	−9,51	−11,41	−11,87	−12,87
	C	−10,10	−12,81	−15,12	−17,19	−16,73	−17,22
	D	−6,97	−8,49	−11,43	−13,19	−12,92	−13,66
	E	−6,31	−8,68	−11,47	−12,92	−12,89	−13,13
® Palatin Fast Bordeaux RN	A	−0,10	−0,93	−0,73	−1,67	−1,54	−2,58
	B	−0,22	−1,10	−1,15	−1,89	−2,08	−2,66
	C	−0,25	−1,02	−0,71	−1,80	−2,05	−2,76
	D	−0,20	−0,87	−0,89	−1,45	−1,58	−1,92
	E	−0,71	−0,97	−1,30	−1,65	−2,04	−2,60
® Palatin Fast Blue GGN	A	−0,07	−0,32	−0,38	−0,62	−0,80	−0,84
	B	−0,47	−0,50	−2,37	−1,28	−1,42	−1,40
	C	−0,45	−0,61	−0,52	−0,93	−1,13	−1,28
	D	−0,30	−0,40	−0,49	−0,96	−1,10	−1,14
	E	−0,20	−0,23	−0,27	−0,64	−1,04	−1,09
® Neolan Brown 2G	A	−1,59	−2,38	−2,86	−3,40	−3,51	−3,98
	B	−1,71	−2,53	−3,09	−3,48	−3,69	−3,96
	C	−1,43	−1,84	−2,36	−2,96	−3,16	−3,88
	D	−1,47	−1,87	−2,29	−2,74	−3,00	−3,75
	E	−1,58	−2,17	−2,52	−3,05	−3,50	−3,88

DELTA-L VALUES AFTER VARIOUS EXPOSURE TIMES (HOURS)

Dye	Fabric	15	30	45	60	75	90
Untreated	A	−0,14	−0,33	0,04	0,14	0,11	0,21
	B	−0,09	−0,45	−0,46	−0,04	−0,12	−0,01
	C	0,28	0,24	0,36	0,37	0,36	0,45
	D	−2,72	−0,46	−0,63	0,13	0,07	0,21
	E	0,10	−0,22	0,40	0,33	0,27	−0,02
® Hostalan Scarlet R	A	0,87	0,87	1,90	2,69	3,09	3,49
	B	1,80	2,43	2,65	3,34	2,67	4,01
	C	0,63	0,04	1,84	1,00	0,65	2,54
	D	1,47	1,93	1,85	2,79	3,27	3,70
	E	2,05	2,50	2,96	3,52	3,85	4,50
® Hostalan Red R	A	2,51	3,13	5,04	6,46	7,42	8,43
	B	2,25	3,55	4,71	5,69	6,87	7,86
	C	2,50	3,97	6,15	7,55	9,08	10,68
	D	2,39	2,01	4,38	5,06	6,68	8,00
	E	3,51	4,72	6,52	8,02	9,09	10,63
® Hostalan Brilliant Red B	A	2,46	3,20	4,50	4,88	6,20	7,10
	B	1,70	2,79	3,45	3,98	5,10	5,73
	C	1,85	3,22	3,89	5,04	5,41	5,61
	D	2,02	2,72	2,77	4,23	4,80	5,84
	E	1,94	2,56	3,71	4,29	5,00	6,04
® Coomassie Red R	A	2,41	3,71	5,08	5,91	7,30	8,25
	B	2,53	3,28	4,70	5,66	6,57	7,36
	C	2,89	4,41	5,49	6,79	8,01	3,55
	D	2,03	3,13	4,42	5,12	5,72	6,74
	E	3,32	4,82	5,81	6,68	7,08	8,76
® Carbolan Crimson BS	A	2,98	4,74	5,96	7,07	8,14	8,68
	B	2,80	4,11	5,60	6,13	7,58	8,00
	C	2,37	4,10	5,35	6,56	7,31	9,24
	D	2,06	3,33	4,54	5,17	5,90	7,27
	E	2,90	4,43	5,74	6,60	7,77	9,26
® Coomassie Brilliant Blue G	A	2,36	5,07	7,05	9,03	11,17	12,62
	B	2,77	5,56	7,81	9,43	11,30	11,74
	C	2,57	4,45	6,08	7,69	9,16	10,58
	D	2,01	3,83	5,66	7,10	8,27	9,41
	E	2,05	3,77	5,54	7,33	8,52	9,90
® Kiton Green B	A	1,59	4,38	6,29	8,11	9,98	11,30
	B	1,11	3,80	5,76	7,07	8,54	9,74
	C	0,86	3,11	4,56	6,69	8,46	9,82
	D	0,94	1,33	2,54	4,30	5,44	7,05
	E	0,97	1,62	3,20	5,09	6,68	8,42
® Kiton Green V	A	−0,10	0,07	0,54	1,40	2,17	3,43
	B	−0,20	−0,17	−0,71	1,23	2,24	2,84
	C	−0,16	−0,55	0,73	1,65	3,15	4,16
	D	−0,82	−0,39	0,00	0,99	2,07	2,81
	E	−0,11	−0,28	0,48	1,24	2,65	3,51
® Lissamine Green SF	A	2,70	2,53	4,64	6,00	7,02	0,97
	B	2,00	2,08	3,47	4,44	5,03	5,89
	C	1,34	3,30	5,34	6,52	7,79	8,43
	D	1,85	3,20	4,51	5,51	6,40	7,10
	E	1,81	3,27	4,49	5,41	6,16	6,80
® Palatin Fast Bordeaux RN	A	0,84	1,58	1,65	2,24	2,25	2,91
	B	−0,31	0,69	1,24	1,46	1,60	2,02
	C	0,40	0,38	0,48	1,58	1,79	2,11
	D	−0,17	0,28	0,43	0,94	1,23	1,49
	E	−0,11	0,84	1,25	1,48	1,94	2,30
® Palatin Fast Blue GGN	A	0,53	0,95	1,43	1,58	1,92	2,28
	B	0,62	1,19	1,62	1,88	2,22	2,54
	C	−0,05	0,50	1,36	1,54	1,81	2,20
	D	0,37	0,57	1,01	1,24	1,48	1,78
	E	0,05	0,30	0,65	0,90	1,15	1,50
® Neolan Brown 2G	A	0,79	0,95	1,42	1,52	1,92	2,16
	B	0,66	1,07	1,18	1,39	1,20	2,06
	C	−0,17	0,73	0,77	1,01	1,69	0,98
	D	−0,23	0,43	0,30	0,88	1,43	0,45
	E	0,21	0,46	0,82	0,83	1,28	1,37